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Innovativeness and Innovation: Implications for the Renewable Materials Supply Chain

Joshua D. Detre[a]Φ Aaron J. Johnson[b] and Allan W. Gray[c]

[a] *Assistant Professor, Department of Agricultural Economics and Agribusiness, Agricultural Center, Louisiana State University, 234 Agricultural Administration Building, Baton Rouge, Louisiana, 70803-5604, U.S.A.*

[b] *Associate Professor, Agricultural Economics and Rural Sociology, University of Idaho, P.O. Box 442334, Moscow, Idaho, 83844-2334, U.S.A.*

[c] *Professor, Department of Agricultural Economics, Purdue University, Krannert 784C, 403 W. State Street, West Lafayette, Indiana, 47907-2056, U.S.A.*

Abstract

This paper leverages the current literature on innovativeness to provide a framework that summarizes the characteristics of firms that exhibit a culture of innovativeness. This framework can assist firms entering the renewable raw materials market in identifying gaps in their internal capacity for innovation as well as the necessary characteristics of supply chain partners that will match their own innovativeness—a necessary albeit insufficient requisite for success in the development of renewable raw materials supply chains.

Keywords: innovativeness, innovation, supply chain management, triple bottom line, corporate social responsibility

Φ Corresponding author: Tel: + 1 225.578.2367
Email: jdetre@agcenter.lsu.edu

Other contact information: A. J. Johnson: aaronj@uidaho.edu
A. W. Gray: gray@purdue.edu

Introduction

The agricultural sector is significantly redefining its traditional markets to include not only food and fiber but also energy, industrial products, and pharmaceutical/health products (Boehlje and Bröring 2011). Indeed, there are indicators that attractive markets may exist for agriculture beyond its traditional markets. For example, Sporleder and Goldsmith (2011) point out that demand for non-biodegradable plant-based plastics is forecasted to increase from just 23,000 metric tons in 2008 to nearly 600,000 metric tons in 2013, replacing a portion of the more traditional petroleum based plastics. As the utilization of renewable raw materials from agriculture is adopted by industries beyond food and fiber, such as the petroleum based and pharmaceutical industries, successful agribusiness companies will likely be characterized by their capacity to provide innovative products and processes both within their firm and across the supply chain of these two industries. These concepts are highlighted in the short description of Syngenta, a multinational agribusiness company, which is pursuing innovative efforts in the sugar industry in an effort to capitalize on society's demand for a renewable fuel supply. Innovation is especially important to firms engaged in emerging markets, like the renewable raw materials markets that agriculture is increasingly engaging in, where change is frequent and the rules and traditions of conducting business are dynamic (Bröring et al. 2006). In the context of renewable markets, innovation must not only produce economically profitable products, but these new products and processes must also meet environmental and social performance metrics increasingly associated with corporate social responsibility (CSR) (Andersson et al. 2005; Amaeshi et al. 2007; Bröring 2009). Moreover, these sustainable innovations will need to extend beyond one individual firm to a connected supply chain of firms needing to innovate together to reach a new market's potential. For example, Sporleder and Goldsmith (2011) point out that supply chain partners in the renewable raw materials chain will likely have to invest in complementary assets for the chain as whole to reach its full potential. These linked investment decisions will require supply chain partners to have a high level of trust, which is more likely to occur among firms with similar goals and cultures.

The linkage between the innovative firm and its supply chain is even more important when one considers that a sustainable supply chain is one of the few remaining ways for a company to achieve a sustainable competitive advantage (SCA) (Markley and Davis 2007).[1] Today's public increasingly demands a sustainable supply chain and this new market is increasing the onus on individual firms to make sure that other firms in the supply chain adopt appropriate management practices if they wish to protect their brands (Amaeshi et al. 2007). To be turned into a SCA, research by Preuss (2005) suggests that firms must work with their supply chain partners, both upstream and down, to deliver a truly sustainable product. Thus, for a firm to be successful in the renewable raw materials market, they must have a culture that puts an emphasis on sustainability and attracts supply chain partners with similar innovative cultures.

[1] In Porter's (1984) seminal book, the phrase sustainable competitive advantage was defined as "the fundamental basis of above-average performance in the long run" (p. 11). Given the very nature of this paper, the word sustainable is occasionally used also in reference to the more modern concepts of environmental, social and economic sustainability. The double use of this term is unavoidable, but care has been taken to remove as much confusion as possible.

While the need for innovation is well recognized, agreement quickly erodes when managers and academics discuss how innovation arises. The myriad of innovation types (Damanpour and Wischnevsky 2006; Armbruster et al. 2008) likely adds to the lack of consensus. For example, one firm in a supply chain may focus on producing innovative products that require intentional and substantial investments in research and development efforts focused on the creation of something new, while other firms in the supply chain focus on innovative business models (e.g., eBay's introduction of online auctions). Still other firms in the supply chain might look to innovate through adoption of the new products developed by innovative product firms. Even though these types of innovations differ and each firm in the supply chain might choose to pursue different forms of innovation, all managers face the question of how they manage for innovation. When managers consistently push their employees to focus on innovation and the creation of something new, they instill a culture in their organization that is centered on recognizing and then capitalizing on opportunities. This type of corporate culture is known as innovativeness, a culture where all employees and functions of the organization seek to innovate. If a culture of innovativeness is going to provide benefits for a renewable raw material supply chain with all of the required metrics of sustainability, then firms all along the renewable supply chain must share a similar culture. The challenge management teams must figure out is how to develop a culture of innovativeness within their firm, and how they ensure their partners in the global renewable supply chain seek to match their innovativeness culture in order to deliver on the common value of sustainability. In the context of renewable markets, solutions to these challenges need to result in economic, social and environmental sustainability, leading to a better triple-bottom line for all supply chain participants (Andersson et al. 2005; Amaeshi et al. 2007; Bröring 2009).

This paper leverages the current literature on innovativeness to provide a framework that summarizes the characteristics of firms that exhibit a culture of innovativeness. This framework can assist firms entering the renewable raw materials market in identifying gaps in their internal capacity for innovation as well as the necessary characteristics of supply chain partners that will match their own innovativeness, a necessary albeit insufficient requisite for success in the development of renewable raw materials supply chains.

Innovativeness Framework

The key tenet of this paper is that until each supply chain member is investing in and implementing an innovativeness culture focused on delivering sustainable products and services through renewable raw materials, the supply chain itself will struggle to be sustainable. The framework in Figure 1 shows how each firm in the supply chain has a set of distinctive characteristics, those that give them a competitive advantage in the marketplace in recognizing opportunities. These characteristics culminate in the firm's strategic culture. The literature suggests that the specific characteristics of a firm associated with strategic intent, organizational structure, and processes can lead to a culture of innovativeness. The discussion that follows explores the characteristics of firms that exhibit a culture of innovativeness.

The literature in business, economics, marketing and psychology fields bear witness to various schools of thought on the topics of innovation typology and managerial intent. Specifically, Fallah and Lechler (2008) identify five key dimensions for managing innovation: (1) innovation,

(2) organization, (3) innovation processes, (4) resource allocation, and (5) innovation culture. They note that these five dimensions are interrelated and understanding these relationships is crucial for a firm seeking to achieve optimal performance from their global innovation strategy. Our focus is on a deeper understanding of the characteristics of an innovation culture.

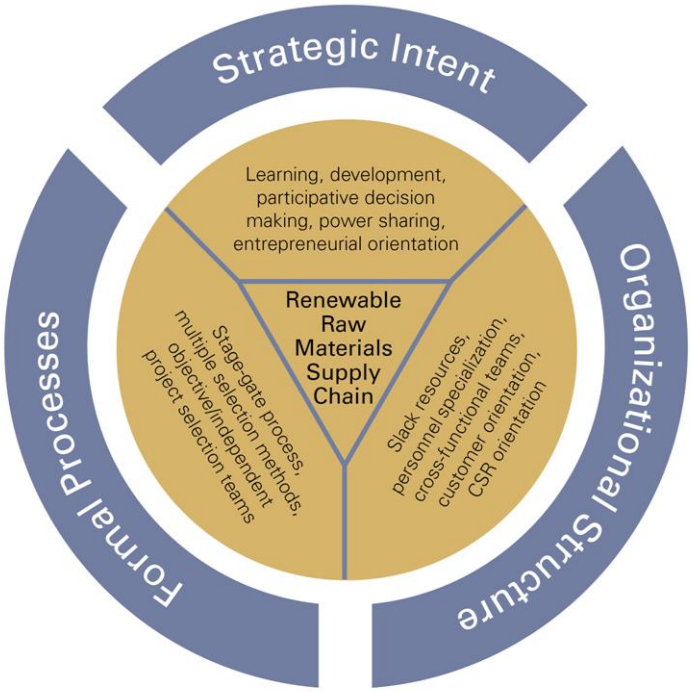

Figure 1. Sustainable Renewable Raw Materials Supply Chain Innovativeness Framework

This paper adopts Hurley and Hult's (1998) definition of innovativeness: "the notion of openness to new ideas as an aspect of a firm's culture…a measure of the organization's orientation toward innovation." Innovativeness deals with the culture and thinking of the firm; innovation is an outcome sought. Given that innovativeness has a direct relationship to innovation, it is expected that firms pursuing innovation as a strategy would pursue innovativeness as part of their culture, striving to make it a core competency. Innovativeness, according to Hurley and Hult (1998), is obtained through "cultures that emphasize learning, development, and participative decision making." And, while it is true that innovativeness is not a sufficient condition to yield innovation, it typically serves as a catalyst for innovations to occur because it creates a firm's internal environment that fosters the exploration of customer information or new operational processes (e.g., the development of new relationship structures with supply chain partners) in ways that fulfill current unmet and/or anticipated future needs.

While conceptually innovativeness makes sense, finding a typology that sufficiently captures innovativeness is a challenge. Many recent studies have concentrated on how firms innovate, and have discovered a positive connection between innovation processes and firm performance (Klomp and Van Leeuwen 2001; Vincent et al. 2004). Despite efforts to explore innovativeness,

its structure and dimensions at the firm level, let alone across a supply chain, are still being developed. In addition, numerous scales for measuring a firm's innovativeness are offered across the literature. As a result, there is no commonly accepted typology and measurement of innovativeness.

Based on Hurley and Hult (1998) and the findings of Klomp and Van Leeuwen (2001) and Vincent et al. (2004), we argue there are three critical dimensions to a culture of innovation: strategic intent, organizational culture, and formal processes. Building a culture of innovativeness through sustained strategic emphasis is an antecedent to consistently delivering innovation. In addition, how the firm implements its innovative culture through its organizational structure and formal processes has a great impact on its success. It is important to note that the degree of flexibility in what is practiced is limited in the strategic emphasis stage but expands with choices a firm has when implementing the strategic emphasis. The innovativeness framework suggested here (presented in Figure 1) draws on the relationship between strategic emphasis, organizational structure and formal processes. Each dimension of innovativeness is explored below to identify specific characteristics of firms that exhibit an innovative culture.

Strategic Emphasis

As pointed out by Subramanian and Nilakanta (1996), "the adoption of innovations by an organization is a consequence of strategic initiatives proactively pursued by decision makers in the organization." They also argue that the adoption of innovativeness as part of a company's culture is a response to the external environment of the firm. Hurley and Hult (1998) argue innovativeness is part of the organizational culture and that this culture embraces the notion of openness to new ideas as an aspect of a firm's culture. Thus, if the top management of a firm makes the decision to compete on innovation, they are making a decision about the culture they want to create and support (Fortuin et al. 2007). Furthermore, the culture of innovativeness is a measure of the organization's orientation toward innovation (Hurley and Hult 1998). If a firm wants to be successful at competing in an innovative industry, it would help its cause by being committed to innovativeness as an organizational culture.

Damanpour (1991) finds cultural items like management's attitude toward change to be positively related to innovation as well. Other research has determined that the mindset of the organization (i.e. their orientation), has a significant role in innovation. In particular, Slater and Narver (1993, 1994, and 1995) note that it is important for firms to have an entrepreneurial mindset, a feat more difficult as companies grow in size. Large, successful firms particularly run the risk of developing established routines and patterns that as a rule have managers following the mantra, "If it's not broke, don't fix it." This entrenchment occurs because these firms face the dilemma of already being committed to the production of a product or service, while the entrepreneurial firms have a greater incentive to replace the status quo. Entrenchment runs counterintuitive to Schumpeter's creative destruction tenant, which revolves around firms in a capitalistic economy making dramatic improvements/innovations in products and/or process that leapfrog the competition in order to achieve monopoly type profits (Schumpeter 1942). Consequently, agribusinesses wanting to break into the renewable materials supply chain must encourage their employees and managers to seek new opportunities, products, services, and ventures that are in line with the company's competencies, even if these projects are risky and

bold. Instead of settling for the status quo, it is crucial that managers continuously seek to improve processes and products. By having an entrepreneurial orientation, a firm improves their innovativeness.

A culture of innovativeness requires that all functional areas – like sales, manufacturing and operations, distribution, information technology, customer relationship management, and human resources – be open and committed to the idea that innovativeness helps to keep the firm's brand relevant to their customers (Gerzema and Lebar 2009). This openness to innovation happens by managing in such a way that the firm's attention is on recognizing the need for new ideas and action in the organization (Van de Ven 1986). To establish this culture, firms must emphasize learning, development, participative decision-making, power sharing, support and collaboration (Hurley and Hult 1998). As Zaltman et al. (1973) note, without this initiation toward innovativeness as part of the culture, it will be difficult for an organization to have success with innovation. Thus, this organizational innovativeness can be conceptualized as an aspect of organizational culture that precedes innovation (Hurley and Hult 1998).

In addition, this also requires that all functional areas be open to the idea of corporate social responsibility (CSR). Zadek (2004) notes that CSR has to be integrated into a company's business model (i.e. with its functional areas). In the long-run, the integration of CSR into the functional areas will help a company begin the process of having an innovativeness culture that is grounded in CSR. Thus, for companies focused on renewable products to be truly innovative, their strategic emphasis will have to have a CSR orientation (Ansett 2007). The ultimate goal is for the company, along with all of its collaborators in the supply chain, to reach what Zadek (2004) calls the "Civil Stage" – i.e. everyone along the chain is employing responsible practices in the products and processes they produce. Before the supply chain reaches the "Civil Stage," a firm must reach the "Strategic Stage" – i.e. it has realized that utilizing responsible business practices in the products they produce and the processes they use to produce them gives their company a competitive edge.

Organizational Structure and Characteristics

Hurley and Hult (1998) indicate that innovativeness of the firm's culture acts in concert with various structural properties of the company to affect the innovative capacity of the organization. Therefore, in addition to establishing a culture of innovativeness, the firm must also pay attention to organizational functions. This focus is especially true with increasing globalization and speed of change, elevating the necessity of a structure that is conducive to innovation by firms if they wish to stay competitive (Damanpour 1991; Fallah and Lechler 2008). Companies must have the willingness to innovate, as well as the capacity and resources to be responsive to the market. If they fail to have the necessary structure in place, they will be unable to turn their will into action, and as a result forego potential future revenue streams. Fortuin et al. (2007) go even further by purporting that if the organizational structure is not conducive for encouraging and enhancing innovation, then the structure will impede successful innovations being brought to the market.

Given the importance and sustained prominence in management, the organizational characteristics that influence innovation have been the subject of numerous studies in varying disciplines (Kimberly and Evanisko 1981; Damanpour 1991; Germain 1996; Subramanian and

Nilakanta 1996; Nystrom et al. 2002; Fallah and Lechler 2008). A distinct set of attributes specific to the organization of a firm have been identified to be more prevalent in innovative firms versus non-innovative firms (Subramanian and Nilakanta 1996). These include the degree to which decision-making is centralized, the degree of formalization in the firm, how much resource slack exists, and the degree of personnel specialization (Damanpour 1991; Subramanian and Nilakanta 1996). Comparing the findings of Damanpour (1991) and Subramanian and Nilakanta (1996) highlight the fact that these are not a one-size-fits-all type of model. For example, Subramanian and Nilakanta (1996) find that formalization and size of a firm lead to the adoption of administrative innovation, while Damanpour (1991) finds that formalization is negatively related to the creation of innovation. However, there is common ground between these studies. Both find slack resources and personnel specialization to be positively correlated with innovation.

With respect to slack resources, Subramanian and Nilakanta (1996) and Damanpour (1991) find that firms who have extra resources that can be dedicated to ideas and opportunities found better success with innovation. Wernefelt (1984) echoed this concept when observing that those firms that derive their competitive advantage from innovativeness do so by funneling resources into the development of new products, processes, and/or services. This does not mean the most innovative firms are the ones who have the largest research budgets, instead; it is those firms that allocate their funds in a method that maximizes earnings. This can only be accomplished if a firm has knowledge of all their competitors' likely responses to any actions that they take and of any first-mover advantages that could be captured by if being the first to market (especially if the innovation is patentable).

Personnel specialization (human capital) refers to the existence of employees within the organization that have particular skills in one or more functional areas of the firm (Subramanian and Nilakanta 1996). While personnel specialization has much to do with education – i.e. firms involved in the renewable biofuels supply chain would need to hire petroleum and agricultural engineers— and having codified operations manuals and procedures (explicit knowledge). The focus also lies with the tacit knowledge that is embedded in the minds of a firm's employee. Tacit knowledge is not easily codified into operations manuals like explicit knowledge. Instead, it is developed over time through experience, training, organizational learning, and education. Thus, unlike explicit knowledge, tacit knowledge is not easily transferable from one employee to the next. However, tacit knowledge when combined with explicit knowledge allows employees to generate ideas that can be turned into products, processes, and/or services with a higher probability of successful commercialization because employees have the ability to understand how these innovations must address societal needs. Moreover, since tacit knowledge is not easily transferable, it requires companies to be diligent in the hiring of new personnel – i.e. businesses must constantly be searching for potential employees who have shown the ability to commercialize their innovations. By focusing on personnel specialization, firms ensure that they have the necessary components in place to be an innovative firm.

A firm whose organizational structure is oriented towards gaining customer insights may greatly improve their chances of success in innovating (Baker and Sinkual 2005; Gourville 2005; Batterink et al. 2006; Grinstein 2008). A customer orientation is driven by the need to have a detailed understanding of what task customers are trying to accomplish, trends in their customer needs, alternative solutions to meet these and latent customer needs. Consequently, customer orientation allows firms to capitalize on both incremental (customer-lead) and radical (lead-the-customer) innovation practices (Baker and Sinkual 2005; Grinstein 2008). If this market knowledge provides new insight, then the company can reshape their effort to help their customers accomplish these tasks more conveniently and efficiently, and/or at a lower cost than before (Slater and Narver 1995). Thus, customer orientation based on learning should aid innovation that improves existing products/services (customer-led/incremental innovation) and/or creates new products/services (lead-the-customer/radical innovation) that improve the competitiveness of the business's customers.

Formal Processes to Manage Innovativeness

Beyond strategic intent and organizational structure, a firm must establish a set of processes that encourage innovativeness and increase the firm's success in commercializing innovations. It is one thing to create the ideology in a firm to seek out creation with every aspect of the company. It is another thing to manage that creation mill in order to maximize profits and minimize risks. Although many ideas fit under this umbrella, we focus on two general managerial objectives: minimizing exposure and allocating resources.

Innovation is risky due to the associated costs and the uncertainty of payoff. Take, for example, new products. They have a failure rate that can be as high as 90% for some product categories (Gourville 2005). This high failure rate is why it is important to manage the innovation effort aggressively to minimize the

Innovativeness in the Biofuels Channel

In 2011, Syngenta Corporation is planning to introduce its innovative new sugar cane product called Plene to the market. Plene is likely to redefine the way sugarcane is planted and ultimately reshape the entire sugar and biofuels industry. Rather than the traditional manual planting system that requires significant labor, Syngenta's new process creates a seed-like product from the sugar cane by precisely cutting it, by machine, into 4-inch pieces that are each capable of growing a new sugar cane plant. These 4-inch pieces can be coated with treatments to protect the seedling from pests and can be sorted and selected for particular characteristics allowing for more efficient improvements in genetics, traits, etc…

Plene was discovered by Syngenta employees that were focusing on the needs of Syngenta's key customers, the sugar processors that had vertically integrated into cane production. The processors had expressed a need to improve the cost of producing their raw materials, reduce the impact of the harsh environment for planting sugarcane for its employees, and allow more sustainable ways to grow the sugar business, particularly as it related to the traditional planting activities for sugar cane.

risks and maximize potential profit. Firms successful at producing serial innovations, for example, have learned how to pull a project before it incurs a significant monetary loss. In other words, successful firms have learned how to fail cheaply (Fortuin et al. 2007). This is in line with Thomke (2003), who purports that failing often is positive if it comes early in the life cycle of the innovation. Therefore, firms should have processes that strategically determine if a company should continue forward with an innovation or if they should redirect or abandon unsuccessful projects at the earliest possible stage of development (Fortuin et al. 2007).

There are numerous processes a firm might adopt to manage this fail-cheap concept. The overriding strategy is for firms to shut down those product and/or process innovations destined for failure as early as possible. Davila et al. (2006) suggest that innovative firms follow one of two strategies for their innovations: 1) The ‘‘Play to Win’’ strategy, where innovation will create the firm’s future core competency; and 2) The “Play Not to Lose’’ strategy, where the company uses innovation to maintain its current competitive advantage. Thus, the culling of those products, processes, or services that are not going to generate profitable growth for the business through the creation or maintenance of core competencies means more resources can be allocated to innovations that can accomplish this task.

Once those products, processes, or services that do not contribute to the core objectives of the firm have been culled from the innovation list, firms need to establish objective criteria for systematically assessing the remaining potential innovations and remove the dead weight from the innovation pipeline. This process is often known as a stage-gate model (Cooper 1985 and 1992). An example metric for judging whether an innovation should continue to receive funding is projected net present value (NPV), which is a staple calculation in capital budgeting analysis. In recent years, software packages, such as @Risk and Crystal Ball, have allowed for the development of complex NPV models that are able to incorporate risk associated with variables that are key to the success of an

Innovativeness in the Biofuels Channel-*Continued*

Because of Syngenta’s strategic emphasis on innovation as their core capability and their pervasive culture of innovation, senior management allowed the team that discovered the sugar processors’ need to pursue alternative solutions over an extended period of time. Syngenta’s organizational structure allows teams to work autonomously to find solutions for their local markets and rewards teams for their ingenuity. In addition, Syngenta has adopted a set of processes and procedures that allow teams, like the Plene team, to access resources and expertise both within the company and outside of the company to assist in the discovery process. Ultimately, this innovativeness culture led to the manufacturing process that creates the Plene product.

However, Plene had no currently available means of reaching the market (there was no machine to plant the new product). Therefore, Syngenta had to seek a supply chain partner to develop a mechanism for planting Plene. They teamed up with John Deere to produce the planter because of John Deere’s record of accomplishment of an innovative culture and John Deere’s desire to enter the sugar cane market. In addition, the true value of Plene to the marketplace will be its ability to deliver improved productivity in terms of genetics, traits, and crop protection.

innovation (costs, competitive response, sales, cannibalization, etc.). In the past four decades, numerous project selection methods have been proposed to help organizations make better decisions regarding innovation. These selection methods include informal methods (Johnston 1988; Whitney 2007), graphical analyses (McGrath and MacMillan 2000; Australian National Audit Office 2003; Day 2007; Huurinainen 2007; Terwiesch and Ulrich 2008), structured assessments (Meade and Presley 2002; Mohanty et al. 2005), economic models (Faulkner 1996; Luehrman 1997; Cooper et al. 2001) and complex models (Graves et al. 2000; Ringuest and Graves 2005). No single selection method presents overwhelming advantages. They all have drawbacks and are actually extremely complementary of each other, leading many such as Cooper et al. (2001) to find that the best innovators use numerous selection methods.

Even with processes in place to act as gates or filters that determine if a project is continued, additional processes are needed to prioritize projects and thus determine allocation of monetary and other resources. Davila et al. (2006) offers, as one example, the idea of a firm setting up their own venture capital system, or granting agency, that distributes funds from the company's innovation budget. For example, firms looking to participate in the renewable fuels supply chain using cellulosic materials might have employees constantly searching for companies that have innovative products and/or processes related to cellulosic materials. The granting agency would be responsible for screening the submitted innovation ideas to make sure they fit with the firm's strategy, perhaps using some combination of the previously mentioned selection methods. In addition, the granting agency would be responsible for ensuring that the company maintained a queued portfolio of innovations to maintain a proper influence in the renewable materials supply chain (Davila et al. 2006).

Davila et al. (2006) also note that a granting type agency is critically important for encouraging radical innovations. Because these types of innovations do not generate short-term profitability and are extremely risky, they run counterintuitive to the goals of managers, whose incentive is to avoid risks and create profits now. By

Innovativeness in the Biofuels Channel-*Continued*

Some of these capabilities are contained within Syngenta, but the expertise in genetics of sugar cane is not. Syngenta has now established research agreements with leading sugar cane genetics companies in Brazil to enhance further the value of Plene to the marketplace. All of these efforts are focused on the renewable raw ingredients marketplace.

While this short description provides only anecdotal evidence of the characteristics of a renewable raw ingredients supply chain that is built on innovation and sustainability, it is illustrative of the types of across supply chain innovations that will be needed to capture the potential of the agricultural industries expansion beyond the traditional food and fiber markets. It is also illustrative of the need to have supply chain partners that have similar cultures and motives. Sporleder and Goldsmith (2010) point out that innovation and supply chains are inextricably linked by the need for complementary assets. In the example, this manifests itself in Syngenta's need for a partner in developing the planting equipment needed and collaborates in enhancing the genetic productivity of sugar cane. All of these partners need to make investments in complementary assets for the innovative new supply chain to come to fruition. This investment in complementary assets does not happen unless the partners all share common elements in their culture to innovate and create markets.

removing the decision from internal management, employees are free to innovate without worrying about repercussions from their immediate supervisors if their innovation fails. Furthermore, these potential innovations, especially the radical ones, will likely generate new competitive advantages, which results in long-term profitability. Without an objective implementation system like the one described here, the incentive for innovativeness by the company's employees can erode over time.

Without a supportive organizational structure and formal processes, firms can fall victim to innovation entrapment (McGrath and MacMillan 2000). Innovation entrapment occurs for a variety of reasons, but chief among them are: the need for people involved with the innovation to defend and confirm their initial decisions and judgment; the desirability of avoiding the waste of sunk costs; the possibility of providing an opportunity for the project to succeed; the treatment of negative feedback as a learning experience (a cue to revise inputs rather than cancel them); and the social costs and benefits, relating to image and reputation, that are at risk if a project is terminated (Proctor 1993). By having a formal and objective criterion and process for evaluating these opportunities, companies are able to lessen the effects of innovation entrapment and increase the incentive for innovation among their employees.

Implications for the Global Renewable Materials Supply Chain

What does the innovativeness framework suggest about a supply chain for renewable raw materials? First, given the global nature and network of most renewable materials supply chains, many of the chain partners are not owned or operated by one company, making diffusion of a common culture of innovativeness difficult. Secondly, many of the chain partners often operate in different countries and the culture of these countries may not place the same emphasis on innovation in a manner that is consistent with CSR. As suggested by Boehlje and Bröring (2011), CSR presents competing dilemmas for firms, especially for firms that operate in countries whose citizens value environmental and social concerns, as they attempt to balance the trade-off between profitability and sustainability. Thus, the formation of a sustainable global renewable materials supply chain whose innovations seek to address the triple bottom line will be difficult. There exists the potential for tremendous future economic growth in bio-renewables as consumers become increasingly concerned with the environmental footprint of companies (Boehlje and Bröring 2011).

To accomplish the aforementioned task, the global renewable materials supply chain will need to establish an efficient method for effective knowledge management transfer. In other words, firms, through knowledge sharing and open innovation, will provide information to chain partners on the processes they use for creating a culture that focuses on delivering sustainable solutions to the problems in the marketplace (McAfee et al. 2002; Peterson 2002; Wadhwa and Saxena 2007). It would seem that the global renewable materials supply chain would be eager to implement such initiatives, especially as they relate to innovation driven by sustainability since the failure to understand the importance of the triple bottom line by any one firm in the chain can lead to significant disruption in the performance for the whole supply chain (Salem, 2009). Zadek (2004) notes that this task is daunting, given the complexity of the issues as well as stakeholders' volatile and sometimes under-informed expectations about businesses' capacities and responsibilities to address societal problems, which would make the need for a method for

effective knowledge management transfer all the more crucial. For example, Solér et al. (2010) find that in supply chains, those firms who are closest to the end-consumer have a better understanding of perceived environmental consumer demand. Recently, retailers like TESCO and Wal-Mart have reacted to this consumer demand for environmental information and have begun tracking the carbon dioxide (CO2) production associated with the products they sell in their stores (Boehlje and Bröring 2011). In this situation, Wal-Mart and TESCO, the firms closest to the end-consumer, must relay this information back through the supply chain to the other chain partners about the demand for products and/or services that comply with the end-consumer's environmental needs. The visibility of these preferences across the renewable materials supply chain would encourage investments in complementary assets and innovative projects, which should improve the profitability of firms across the supply chain and capture first-mover advantages (Jansen and Vellema 2004; Esty and Winston 2006; Sporleder and Goldsmith 2011). Thus, it is critical that firms all along the supply chain understand that by addressing sustainability issues, they will be able to create value.

Ansett (2007) goes on to note that individual companies cannot solve these societal issues alone, and that it will take companies along the supply chain working together, i.e. by combining and sharing their respective competencies, expertise, knowledge, and resources, to develop solutions. This will require the renewable materials supply chain to host multi-stakeholder meetings that allow for the development of new relationships and learning from peer companies, trade unions, non-government organizations, etc., to find solutions for creating a supply chain that meets the needs of a social and value-generating civil society, while at the same time creating profit for the supply chain members (Peterson 2002; Ansett 2007). Boehlje and Bröring (2011) indicate that the participation in a sustainable supply chain will require that all firms understand the opportunities and challenges a sustainable bioeconomy creates for them and that the only way to capitalize on these opportunities and minimize the challenges is to pursue innovation that is driven with technical efficiency and social legitimacy. These meetings and initiatives will require active participation from all chain partners, and likely be driven by leading multinational agribusiness companies.

Agricultural firms involved in new markets, such as the renewable fuels market, should seek to align themselves with partners who value CSR and seek innovative solutions that credibly respond to society's changing awareness of particular social issues (Zadek 2004). For example, Salem (2009) suggests that chain partners should seek to employ Purchasing Social Responsibility (PSR) -- i.e. an agricultural firm would seek to purchase inputs and sell outputs to partners that are socially responsible, and by doing so would create competitive advantages for both the firm and its chain partners. In addition, research shows that chain partners with shared values (in this case, a commitment to innovations that address the triple bottom line) have positive influence on both commitment and trust between chain partners (McAfee et al. 2002). These concepts can be readily demonstrated by returning to the renewable fuels example, where chain partners are likely to include raw material producers (likely farmers), handlers (such as grain elevators), and/or processors of raw materials to be used as replacements for the nonrenewable products. Due to the newness of this market for these players, the supply chain partners will have to innovate the products they produce, the processes used for producing and handling them, as well as the market mechanisms used to determine the sharing of profits and risk among supply chain partners. In the U.S., for example, much of the current research suggests

that the most efficient way to produce cellulosic fuels is likely to come from crops such as Miscanthus. However, developing a supply chain for cellulosic fuels will require innovation from farmers in terms of the type of crops they produce, equipment manufacturers to develop mechanical means for harvesting the crop, and logistics companies to ship the material from the farms to the cellulosic ethanol plants. Relative to current markets, a market for Miscanthus to replace crude oil as a raw material in the production of liquid energy would be a significant innovative undertaking. As such, our innovativeness model would suggest that individual firms that are more similar with respect to innovativeness as a culture will be more likely to work together given that there is less flexibility with this set of decisions. If all of the chain partners are committed to CSR and they engage in knowledge sharing when innovating the products and process used to meet the demands of this new market, the development of the renewable fuels will be more efficient and effective.

Conclusion and Summary

Firms in a supply chain focused on the market for renewable raw materials, a new and dynamic market that is marked with dynamism and emerging rules will need a strategic emphasis on innovativeness within firms and across the supply chain to be successful and sustainable. The framework presented in this paper summarizes the characteristics of firms that pursue a culture of innovativeness. Regardless of whether a company is trying to manage production innovation, business model innovation, and/or adoption innovation, the company must first have a culture of innovativeness if it hopes to realize success repetitively. Even if the structure and implementation of innovation are different for each of the businesses involved in the supply chain, they will share common characteristics about the value of innovation as a part of their strategy, the necessary organizational structures, and formal processes necessary to deliver the innovative solutions that are aligned with CSR and the triple bottom line that underlies the movement to renewable raw materials.

In the nascent renewable raw materials supply chain, individual companies will be challenged to create a shared value among all supply chain partners of what innovations will be necessary in the production, handling and processing of the raw materials, and the appropriate sharing of risk and rewards to incent each supply chain partner to participate fully. In particular, long-term success for the renewable materials supply chain will require that each player understands the tasks users of renewable materials are trying to accomplish and a commitment to strengthening the perceived value of renewable raw materials relative to non-renewable raw materials through innovations in products, processes, and business models. The most likely path to success will be a global renewable supply chain populated by firms with a similar culture of innovativeness dedicated to finding sustainable solutions to societal problems.

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